CLAIMS

1. Two-dimensional detector of incident ionizing radiation composed of first particles, this detector comprising a stack (2) of sheets (4) of a first material capable of emitting second particles by interaction with the incident ionizing radiation, this detector being characterized in that it also comprises:

- layers (6) of a semiconducting material that alternate with sheets of the first material and may be ionized by the second particles, each of the layers being associated with one of the sheets, the stack having opposite first (8) and second (10) faces each containing corresponding edges (12, 14) of sheets and layers, the detector being designed to be laid out such that the ionizing radiation arrives on the first face (8), the length of each sheet measured from the first as far as the second face being equal to at least one tenth of the free average path of the first particles in the first material,
- groups of parallel and electrically conducting tracks (22) extending from the first to the second face parallel to the layers (6), each group being associated with one of the layers and in contact with it, the tracks being designed to collect charge carriers that are generated in the layers by interaction of the layers with the second particles and possibly with the first particles and that are representative of the first particles in intensity and in position, and

- means (26) of creating an electric field capable of causing collection of charge carriers through the tracks (22).

2. Detector according to claim 1, in which the first material is electrically conducting, the tracks (22) are electrically insulated from the sheets and the means of creating the electric field comprise means (26) of applying a voltage between the tracks (22) and the sheets (4), this voltage able to cause collection of charge carriers through the tracks.

3. Detector according to claim 1, in which each group of tracks (22) is fully located within the layer (6) with which it is associated.

4. Detector according to claim 3, in which the first material is electrically conducting and the means of creating the electric field comprise means (26) of applying a voltage between the tracks (22) and the sheets (4), this voltage able to cause collection of charge carriers through the tracks.

5. Detector according to either of claims 1 or 3, in which the sheets (4) are electrically insulating, an electrically conducting layer (46) is inserted between each layer (6) of semiconducting material and the sheet (4) that is associated with it and the means of creating the electric field comprise means (26) of applying a voltage between the tracks (22) and the electrically conducting layers (46), this voltage able to cause collection of charge carriers through the tracks.

6. Detector according to any one of claims 1 or 5, in which the semiconducting material may be chosen among the group including thin layers of diamond, CdTe, ZnTe, CdZnTe, AsGa and their alloys, InP, InSb, SiC,

crystalline silicon, amorphous silicon, organic crystals, amorphous selenium and chalcogenic glass (As_2S_3).

7. Detector according to any one of claims 1 to 6, also comprising an electronic device (30) for reading electrical signals output by tracks (22) when the tracks collect charge carriers.

8. Detector according to claim 7, in which one end (32) of each track is curved to extend onto an edge (14) of the corresponding layer (6) of semiconducting material, this edge being located on the second face (10) of the stack (2), and the device (30) comprises electrically conducting pads (34) that are in contact with the corresponding curved ends (32) of the tracks (22).

9. Process for manufacturing the detector according to any one of claims 1 to 8, in which a layer (6) of semiconducting material is formed on each sheet (4), this layer being provided with the group of tracks (22) associated with it, and the sheets provided with layers of semiconducting material and tracks are assembled together to obtain a stack (2) in which these layers of semiconducting material alternate with the sheets (22).

10. Process according to claim 9, in which a first layer of semiconducting material is formed on each sheet (4), the thickness being less than the thickness of the said layer (6) of semiconducting material, the group of tracks (22) is formed on this first layer and a second layer of semiconducting material that covers these tracks is formed on the first layer, the total thickness of the first and second layers being equal to

the thickness of the said layer (6) of semiconducting material.

11. Process for manufacturing the detector according to any one of claims 1 to 8, in which a half layer of semiconducting material is deposited on the two opposite faces of two successive sheets (4), and then the group of tracks (22) is formed on one of the half layers and the sheets thus covered are assembled together to create a stack in which the layers alternate with the sheets.